

NEW ENGLAND NOTE

FLORAS OF PEQUAWKET AND HEATH POND BOGS,
OSS�PEE, NEW HAMPSHIRE

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Pequawket Bog and Heath Pond Bog are located in the Town of Ossipee, near the town line, in Carroll County, New Hampshire. Although the two sites lie approximately one mile apart (Figure 1), the floristic and vegetational differences exhibited by each peatland are striking.

Pequawket Bog, situated between Long Sands Road and Pequawket Trail, off State Route 25, is a peatland of approximately 9.9 hectares (24.4) acres, including a 2.8 hectare (7 acre) pond. The peatland complex has a large sedge meadow, dominated by *Carex lasiocarpa*, on the northwest side of the pond, while the east, south, and west sides have a more typical bog flora, with a deep sphagnum mat and low ericaceous shrubs. A detailed site description and vegetation analysis are provided elsewhere (Fahey 1993; Fahey and Crow 1995).

Heath Pond Bog, located approximately 2 miles northeast of the village of Center Ossipee, along State Route 25, is a peatland of approximately 16.2 hectares (40 acres), including a 2-hectare (5-acre) pond. The floating mat around the pond is, on average, approximately 3 m wide. Immediately around the floating mat, and on the extensive mat west of the pond, ericaceous shrubs and scattered *Picea mariana* and *Larix laricina* of dwarfed stature dominate. Further site information and description of the flora and vegetation are given elsewhere (Fahey 1993).

Heath Pond Bog has been a point of interest to professional and amateur botanists for many years, and as a result of their efforts, the site was designated a National Natural Landmark in July, 1972. While it was regarded as a “classic example of bog succession” containing a “greater variety of plants than known in any other peat bog in the state” (Steele, in Lyon and Reiners 1972, p. 61), our study has revealed that nearby Pequawket Bog, apparently unknown to Steele and colleagues, has even greater species diversity.

As part of a detailed study of the flora and vegetation of Pequawket and Heath Pond Bogs during the summer of 1991, total inventories of



Figure 1. Aerial photograph of Pequawket Bog (lower right), and Heath Pond Bog (far upper left), looking westward.

the vascular plant species found in the two peatlands were carried out (Fahey 1993; Fahey and Crow 1995); numerous additional visits to the peatlands have occurred annually. During the growing season the sites were visited no less than once a week. Nomenclature follows Crow and Hellquist (2000a, b) and Gleason and Cronquist (1991).

The vascular flora of Pequawket Bog consists of 44 families, 80 genera, and 109 species; 5 pteridophytes, 4 gymnosperms, and 100 angiosperms (53 dicots and 47 monocots). The predominant families are the Cyperaceae (21 species; 19.3% of total flora) and the Ericaceae (11 species; 10.0% of total flora).

The vascular flora of Heath Pond Bog consists of 26 families, 47 genera, and 72 species; 2 pteridophytes, 4 gymnosperms, and 66 angiosperms (35 dicots and 31 monocots). Three species (*Arethusa bulbosa*, *Carex pauciflora*, *Platanthera blephariglottis*) have been documented by herbarium specimens in the past, but were not seen during the summer of 1991 nor in subsequent annual visits. One species (*Arceuthobium pusillum*) was added to the flora in 1994. The predominant families are the Cyperaceae (20 species; 28.2% of total flora) and the Ericaceae (12 species; 18.3% of total flora).

In order to compare floristic similarities between the two peatlands, a Sørensen Index of Similarity was calculated. This method of data analysis uses the number of species shared between two sites (c), and the total number of species for each of the two sites in question (a and b) to determine the similarity of the two floras with respect to species composition (Mueller-Dombois and Ellenberg 1974). Sørensen's Index is calculated as follows:

$$SI = [2c \div (a + b)] \times 100$$

The Sørensen Similarity Index (SI) provides a value that represents the percentage of species in common between the two floras (Mueller-Dombois and Ellenberg, 1974). According to Barbour et al. (1987), in comparing any two plant communities, a similarity index greater than 50% would indicate strong similarity and the two communities could be viewed as representing the same association. Pequawket Bog and Heath Pond Bog have 58 species in common, giving a Sørensen Similarity Index value of 64.08%. For perspective, C. Eric Hellquist's (1994) comparison of floristic similarity among several New Hampshire bogs revealed a similar value between the bog he studied in Moultonborough and Pequawket Bog (SI = 64.4%), but a lower value between the Moultonborough bog and Heath Pond Bog (SI = 49.5%). The highest percentage of similarity Hellquist noted was between Pequawket Bog and a bog in Hillsborough,

New Hampshire studied by Debra Dunlop (1987), with an SI value of 75.2%. Both bogs had a much lower similarity index with a bog studied by Crow (1969) in Michigan (Pequawket Bog, SI = 45.0%; Heath Pond Bog, SI = 29.9%). These values reflect the complex nature of factors affecting the floristic makeup of peatland vegetation—factors such as differences in basin morphology, hydrology, nutrient regimes, local topography, and floristic composition of the vegetation of the area.

The floras of the two peatlands are presented in Table 1. The checklists are presented in this format to allow botanists and students visiting these two sites to compare species present in each of the bogs.

The current *Plant Tracking List* of the New Hampshire Natural Heritage Bureau (2003) was consulted to determine if any of these species had special protected status in the state. Several plants occurring in the peatlands are noteworthy. *Eriophorum angustifolium*, an endangered species for New Hampshire, was first reported for the state from Heath Pond Bog in 1984 (Brackley and Crow 1989). This species was also found in Pequawket Bog during this study, and its presence represents a second station for this species in the state of New Hampshire. *Arethusa bulbosa*, documented from Heath Pond Bog by a voucher specimen dated June 29, 1937, at the University of New Hampshire (NHA; acc. no. 74765—no collector indicated, but from collection given to NHA by Frederic Steele), but not documented from there since, also has “Endangered” status in New Hampshire. A second herbarium sheet (NHA; acc. no. 81316) has a handwritten note in Frederic Steele’s hand, noting that he had checked Heath Pond Bog on June 16 and 23, 1971, but found no plants of this species. Brumback and Mehrhoff, et al. (1996) have listed *A. bulbosa* in *Flora Conservanda*, the list compiled by New England Plant Conservation Program (NEPCoP), noting that this orchid is in decline in Connecticut, Massachusetts, Rhode Island, and Vermont. Other plants included on the current *Plant Tracking List* of the New Hampshire Natural Heritage Bureau (2003) present in both peatlands include *Calopogon tuberosa*, *Platanthera blephariglottis*, *Pogonia ophioglossoides*, and *Sarracenia purpurea*. These four species are listed as “Special Concern” status. One additional species, *Potamogeton confervoides*, is listed as “State Watch” status on an unpublished list of plants that have the potential of being raised to the unofficial status category “protected” by the New Hampshire Natural Heritage Bureau; it is also listed in *Flora Conservanda* (Brumback and Mehrhoff 1996).

Table 1. The floras of Pequawket and Heath Pond Bogs (historical records indicated as H). Voucher specimens are cited in Fahey (1993) and housed in NHA.

| Species | Pequawket Bog | Heath Pond Bog |
|---|------------------|-------------------|
| <i>Acer rubrum</i> L. | X | X |
| <i>Alnus incana</i> subsp. <i>rugosa</i> (Du Roi) Clausen | X | |
| <i>Amelanchier canadensis</i> (L.) Medik. | X | X |
| <i>Andromeda glaucophylla</i> Link | X | X |
| <i>Apios americana</i> Medik. | X | |
| <i>Arceuthobium pusillum</i> Peck | | X |
| <i>Arethusa bulbosa</i> L. | | H |
| <i>Aronia melanocarpa</i> (Michx.) Elliott | X | X |
| <i>Aster nemoralis</i> Aiton | X | |
| <i>Betula populifolia</i> Marshall | X | X |
| <i>Bidens cernua</i> L. | X | |
| <i>Brasenia schreberi</i> J.F. Gmel. | X | |
| <i>Calamagrostis canadensis</i> (Michx.) P. Beauv. | X | |
| <i>Calla palustris</i> L. | X | |
| <i>Calopogon tuberosus</i> (L.) Britton, Sterns & Poggenb. | X | X |
| <i>Carex atlantica</i> Bailey subsp. <i>atlantica</i> | | X |
| <i>Carex atlantica</i> subsp. <i>capillacea</i> (Bailey) Reznicek | X | |
| <i>Carex canescens</i> L. | X | X |
| <i>Carex crinita</i> Lam. var. <i>crinita</i> | X | |
| <i>Carex echinata</i> Murray | X | |
| <i>Carex folliculata</i> L. var. <i>folliculata</i> | X | X |
| <i>Carex gynandra</i> Schwein. | | X |
| <i>Carex lasiocarpa</i> var. <i>americana</i> Fernald | X | |
| <i>Carex limosa</i> L. | | X |
| <i>Carex lurida</i> Wahlenb. | | X |
| <i>Carex oligosperma</i> Michx. | X | X |
| <i>Carex pauciflora</i> Lightf. | | H |
| <i>Carex scoparia</i> Schkuhr ex Willd. | X | X |
| <i>Carex stricta</i> var. <i>strictior</i> (Dewey) Carey | X | X |
| <i>Carex trisperma</i> Dewey | X | X |
| <i>Carex utriculata</i> Boott | X | |
| <i>Carex vesicaria</i> L. | | X |
| <i>Cephalanthus occidentalis</i> L. var. <i>occidentalis</i> | X | |
| <i>Chamaedaphne calyculata</i> (L.) Moench | X | X |
| <i>Cladium mariscoides</i> (Muhl.) Torr. | X | X |
| <i>Coptis trifolia</i> var. <i>groenlandica</i> (Oeder) Fassett | | X |
| <i>Cornus stolonifera</i> Michx. | X | |
| <i>Dalibarda repens</i> L. | X | |
| <i>Decodon verticillatus</i> (L.) Elliott | X | X |
| <i>Drosera intermedia</i> Hayne | X | X |
| <i>Drosera rotundifolia</i> L. | X | X |
| <i>Dulichium arundinaceum</i> (L.) Britton | X | X |
| <i>Eleocharis robbinsii</i> Oakes | X | |
| <i>Eleocharis smallii</i> Britton | X | |

Table 1. Continued.

| Species | Pequawket | | Heath | |
|---|-----------|--|-------|-----|
| | Bog | | Pond | Bog |
| <i>Eriocaulon aquaticum</i> (Hill) Druce | X | | | |
| <i>Eriophorum angustifolium</i> Honck. | X | | X | |
| <i>Eriophorum tenellum</i> Nutt. | X | | | |
| <i>Eriophorum vaginatum</i> subsp. <i>spissum</i> (Fernald) Hultén | X | | X | |
| <i>Eriophorum virginicum</i> L. | X | | X | |
| <i>Euthamia graminifolia</i> (L.) Nutt. ex Cass. var. <i>graminifolia</i> | X | | | |
| <i>Galium trifidum</i> L. | X | | | |
| <i>Gaultheria procumbens</i> L. | X | | X | |
| <i>Gaylussacia baccata</i> (Wangenh.) K. Koch | X | | X | |
| <i>Glyceria canadensis</i> (Michx.) Trin. | X | | X | |
| <i>Ilex verticillata</i> (L.) A. Gray | X | | X | |
| <i>Iris versicolor</i> L. | X | | X | |
| <i>Juncus canadensis</i> J. Gay | X | | | |
| <i>Juncus effusus</i> L. | X | | X | |
| <i>Juncus pelocarpus</i> E. Mey. | X | | | |
| <i>Kalmia angustifolia</i> L. | X | | X | |
| <i>Kalmia polifolia</i> Wangenh. subsp. <i>polifolia</i> | X | | X | |
| <i>Larix laricina</i> (Du Roi) K. Koch | X | | X | |
| <i>Ledum groenlandicum</i> Oeder | | | X | |
| <i>Leersia oryzoides</i> (L.) Sw. var. <i>oryzoides</i> | X | | | |
| <i>Lycopus uniflorus</i> Michx. | X | | | |
| <i>Lyonia ligustrina</i> (L.) DC. var. <i>ligustrina</i> | X | | X | |
| <i>Lysimachia terrestris</i> (L.) Britton, Sterns & Poggenb. | X | | X | |
| <i>Maianthemum canadense</i> Desf. var. <i>canadense</i> | X | | | |
| <i>Menyanthes trifoliata</i> var. <i>minor</i> Raf. | X | | | |
| <i>Mitchella repens</i> L. | | | X | |
| <i>Myrica gale</i> L. | X | | | |
| <i>Nemopanthus mucronata</i> (L.) Trel. | X | | X | |
| <i>Nuphar variegata</i> Engelm. ex Durand | X | | X | |
| <i>Nymphaea odorata</i> Aiton subsp. <i>odorata</i> | X | | | |
| <i>Nymphoides cordata</i> (Elliott) Fernald | X | | X | |
| <i>Onoclea sensibilis</i> L. | X | | | |
| <i>Osmunda cinnamomea</i> L. | X | | X | |
| <i>Osmunda regalis</i> var. <i>spectabilis</i> (Willd.) A. Gray | X | | | |
| <i>Peltandra virginica</i> (L.) Schott & Endl. | X | | X | |
| <i>Picea mariana</i> (Mill.) Britton, Sterns & Poggenb. | X | | X | |
| <i>Pinus rigida</i> Mill. | X | | X | |
| <i>Pinus strobus</i> L. | X | | X | |
| <i>Platanthera blephariglottis</i> (Willd.) Lindl. | X | | H | |
| <i>Pogonia ophioglossoides</i> (L.) Ker-Gawl. | X | | X | |
| <i>Pontederia cordata</i> L. | X | | | |
| <i>Potamogeton amplifolius</i> Tuck. | X | | | |
| <i>Potamogeton confervoides</i> Rchb. | X | | | |
| <i>Potamogeton epihydrus</i> var. <i>ramosus</i> (Peck) House | X | | | |
| <i>Potamogeton natans</i> L. | X | | | |

Table 1. Continued.

| Species | Pequawket Bog | Heath Pond Bog |
|---|------------------|-------------------|
| <i>Potamogeton oakesianus</i> J.W. Robbins | X | |
| <i>Rhododendron canadense</i> (L.) Torr. | X | X |
| <i>Rhynchospora alba</i> (L.) Vahl | X | X |
| <i>Rosa nitida</i> Willd. | X | |
| <i>Rubus hispidus</i> L. | X | X |
| <i>Sagittaria latifolia</i> Willd. | X | |
| <i>Salix discolor</i> Muhl. | X | |
| <i>Sarracenia purpurea</i> L. | X | X |
| <i>Scheuchzeria palustris</i> subsp. <i>americana</i> (Fernald) Hultén | X | |
| <i>Scirpus cyperinus</i> (L.) Kunth | X | X |
| <i>Scirpus microcarpus</i> J. Presl & C. Presl | | X |
| <i>Smilacina trifolia</i> (L.) Desf. | X | X |
| <i>Sparganium americanum</i> Nutt. | X | |
| <i>Spiraea latifolia</i> (Aiton) Borkh. | X | X |
| <i>Spiraea tomentosa</i> L. | X | |
| <i>Symplocarpus foetidus</i> (L.) Nutt. | X | X |
| <i>Thelypteris palustris</i> var. <i>pubescens</i> (Lawson) Fernald | X | |
| <i>Toxicodendron vernix</i> (L.) Kuntze | X | |
| <i>Triadenum virginicum</i> (L.) Raf. | X | X |
| <i>Trientalis borealis</i> Raf. | X | |
| <i>Utricularia cornuta</i> Michx. | X | X |
| <i>Utricularia geminiscapa</i> Benj. | | X |
| <i>Utricularia intermedia</i> Hayne | X | |
| <i>Utricularia purpurea</i> Walter | X | |
| <i>Utricularia vulgaris</i> subsp. <i>macrorhiza</i> (LeConte) Clausen | X | |
| <i>Vaccinium corymbosum</i> L. | X | X |
| <i>Vaccinium macrocarpon</i> Aiton | X | X |
| <i>Vaccinium myrtilloides</i> Aiton | | X |
| <i>Vaccinium oxycoccos</i> L. | X | X |
| <i>Viburnum cassinoides</i> L. | X | X |
| <i>Viburnum recognitum</i> Fernald | X | |
| <i>Viola macloskeyi</i> subsp. <i>pallens</i> (Banks ex DC.) M.S. Baker | X | |
| <i>Woodwardia virginica</i> (L.) Sm. | X | X |
| <i>Xyris montana</i> Ries | X | X |
| TOTAL | 109 | 72 |
| SHARED SPECIES: 58 | | |

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LITERATURE CITED

- BARBOUR, M. G., J. H. BURK, AND W. D. PITTS. 1987. *Terrestrial plant ecology*, 2nd ed. The Benjamin/Cummings Publishing Co., Reading, MA.
- BRACKLEY, F. E. AND G. E. CROW. 1989. Notes on the rare flora of New Hampshire. *Rhodora* 91: 103–109.
- BRUMBACK, W. E. AND L. J. MEHRHOFF, ET AL. 1996. *Flora Conservanda*: New England. The New England Plant Conservation Program (NEPCoP) list of plants in need of conservation. *Rhodora* 98: 233–361.
- CROW, G. E. 1969. Species of vascular plants of Pennfield Bog, Calhoun County, Michigan. *Michigan Bot.* 8: 131–136.
- CROW, G. E. AND C. B. HELLQUIST. 2000a. *Aquatic and Wetland Plants of Northeastern North America, Vol. 1. Pteridophytes, Gymnosperms, Angiosperms: Dicotyledons*. Univ. Wisconsin Press, Madison, WI.
- AND ———. 2000b. *Aquatic and Wetland Plants of Northeastern North America, Vol. 2. Angiosperms: Monocotyledons*. Univ. Wisconsin Press, Madison, WI.
- DUNLOP, D. A. 1987. Community classification of the vascular vegetation of a New Hampshire peatland. *Rhodora* 89: 415–440.
- FAHEY, L. L. 1993. A vegetation, floristic, and phytogeographic analysis of two New Hampshire peatlands. M.S. thesis, Univ. New Hampshire, Durham, NH.
- AND G. E. CROW. 1995. The vegetation of Pequawket Bog, Ossipee, New Hampshire. *Rhodora* 97: 39–92.
- GLEASON, H. A. AND A. CRONQUIST. 1991. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*, 2nd ed. The New York Botanical Garden, Bronx, NY.
- HELLQUIST, C. E. 1994. The flora of Mud Pond Bog, Moultonborough, New Hampshire. Honors Senior thesis [unpublished], Dept. Plant Biology, Univ. New Hampshire, Durham, NH.
- LYON, C. J. AND W. A. REINERS, eds. 1972. *Natural areas of New Hampshire suitable for ecological research*. Publ. No. 4, Dept. Biological Sciences, Dartmouth College, Hanover, NH.
- MUELLER-DOMBOIS, D. AND H. ELLENBERG. 1974. *Aims and Methods of Vegetation Ecology*. John Wiley & Sons, New York.
- NEW HAMPSHIRE NATURAL HERITAGE BUREAU. 2003. Plant tracking list: Including species listed as threatened or endangered under the N.H. Native Plant Protection Act of 1987. Technical Copy, New Hampshire Natural Heritage Bur., Div. Forests Lands, Concord, NH. Website (http://www.nhdf.org/formgt/nhiweb/lists_&_reports_online.htm). Accessed 1 Oct. 2004.